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Chemical composition of volcanic gases emitted during the 2014-15 Fogo eruption, Cape Verde

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Pico do Fogo volcano (2,800 m) is the youngest and most active volcano of the Cape Verde archipelago and is located in Fogo Island. In November 23, 2014, a new volcanic eruption occurred at the west flank of Pico do Fogo, near the site of the 1995 eruption. From November 28, 2014, daily SO_2 ground-based plume measurements have been performed by ITER/INVOLCAN/UNICV/OVCV/SNPC research team, representing the first SO_2 plume measurements ever performed during an eruption of this volcano. Measurements were carried out with a miniature ultraviolet (UV) spectrometer miniDOAS to estimate the SO_2 emission from the volcanic plume. On November 30th by combining mini-DOAS and a portable multi-sensor gas (Shinohara et al., 2005), we were able to quantify the SO_2, H2S, H2, CO_2 and H_2O emission rates from the plume. Multi-sensor gas measurements were performed about 1 km distance from the eruptive vent. Average SO_2 emission rate calculated from 4 traverses on November 30, 2014, was 117 kg s-1 (10,118 t d-1). Combining this value with the estimated average CO_2/SO_2, SO_2/H2S, and H2S/H2 and H_2O/SO_2 mass ratios (1.06, 178, 568 and 2.40, respectively), we calculated the CO_2, H2S, H2 and H_2O plume emissions: 124 kg s-1 (10,688 t d-1), 0.7 kg s-1 (57 t d-1), 0.2 kg s-1 (18 t d-1), and 281 kg s-1 (24,245 t d-1), respectively. Plume gas composition obtained in November 30 indicated average CO_2/SO_2, CO_2/H_2O and SO_2/H2S molar ratios of 1.5, 0.3 and 7.5, respectively. These values were remarkably different from those molar ratios measured at the fumarole discharges from summit crater previously to the eruption onset, and representative of the ascent of magma to the surface and the injection of SO_2-rich hot magmatic gases in the H2S-rich hydrothermal system of Pico do Fogo volcano as was observed through the increase on the SO_2/ H2S and decrease on the CO_2/SO_2 measured molar plume ratios. Based on the measured chemical composition of the plume, the apparent equilibrium temperature (AET) was estimated following the method reported by Ohba et al., 1994 in 1,265ºC, value typical of basaltic magmas.

Ohba, T., Hirabayashi, J., Yoshida, M., 1994. Equilibrium temperature and redox state of volcanic gas at Unzen volcano, Japan. J. Volcanol. Geotherm. Res. 60, 263-272.
Shinohara, H., 2005. A new technique to estimate volcanic gas composition: plume measurements with a portable multi-sensor system. J. Volcanol. Geotherm. Res. 143, 319–333.